

**Screening Level Human Health Risk Evaluation of Land Crab Consumption**  
**Exposure Pathway:**  
**Commonwealth Oil Refining Company, Inc.**  
**Penuelas, Puerto Rico**  
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## **1. Introduction**

Consumption of the mangrove land crab (*Cardisoma guanhumi*) has been identified as a potential pathway of human exposure to constituents identified in sediment in areas adjacent to the subject site. These adjacent areas include Flores Park, Jakes Lagoon and the effluent channel leading away from the former refinery and tank farm facility. The crab is a terrestrial crustacean that is herbivorous in its feeding strategy; its primary food items are leaves, fruits, berries and flowers. The constituents evaluated here are the diesel range fraction of total petroleum hydrocarbons (TPH) and the polycyclic aromatic hydrocarbons (PAHs).

This evaluation is a qualitative screening level assessment of the potential for human health risk as a result of consumption of land crabs that are assumed to have been exposed to chemical constituents reported in sediment in the affected areas described above.

## **2. Summary of Site Data**

The only reported constituent in sediment at both Flores Park and Jakes Lagoon is the diesel range of TPH (maximum reported values: 27 and 16 mg/kg, respectively). The gasoline and oil range of TPH and benzene, toluene, ethylbenzene and xylene (BTEX) were reported as non-detect (ND) at these locations. PAH analyses were performed along the length of the effluent channel; reported concentrations range from ND to 70 mg/kg for non-carcinogenic PAHs (fluorene) to 13 mg/kg for carcinogenic PAHs (chrysene; Applied Geosciences and Environmental Services, Inc., September 8, 2005 and September 8, 2005.)

## **3. Evaluation of Exposure Pathway**

It has been determined that crab trapping occurs in the areas under study. However, for human exposure to the site constituents to occur through the crab consumption pathway, the chemical constituents must biomagnify from soil and sediment through the food chain and accumulate in the crab's edible tissue. Additionally, for significant health risk to occur, the exposed person must consume a sufficient amount of affected tissue to exceed the health threshold levels of the chemical. This process is unlikely to occur for the following reasons:

*Weak tendency for site constituents to biomagnify:* it is widely recognized that chemicals such as the petroleum hydrocarbons, low molecular weight volatiles and the PAHs do not exhibit a strong tendency to bioaccumulate or biomagnify, especially in higher trophic species. Chemical most commonly recognized as potential bioaccumulators are certain metals, pesticides, PCBs and dioxins (TNRCC, 2001). A chemical's tendency for this process is estimated by its log  $K_{ow}$  and the bioconcentration factor (BCF). The log  $K_{ow}$  is derived from the octanol water partition coefficient, which represents a chemical's ability to dissolve in organic solvents or lipids; the BCF represents the ratio of chemical in tissue relative to the surrounding environmental medium. In general chemicals that have a BCF of less than 1000 or a log  $K_{ow}$  of less than 5.0 are not considered to have significant potential for bioaccumulation or biomagnification. Most PAHs have a log  $K_{ow}$  less than 5.0 (U.S. Navy, Environmental Restoration Division, 1999 and 2001). Experimental studies have also demonstrated BCFs for PAHs at either near 1000 or significantly less (Ministry of Environment, Lands and Parks, 1993). Finally, the depuration (metabolism and excretion of PAHs) in higher level aquatic species has been well demonstrated (TNRCC, 2001).

*Foraging strategy of the crab:* this species of crab is primarily terrestrial and feeds upon vegetation. It does not typically inhabit aquatic environments except for drinking or the reproductive cycle. In general, this species of crab would not be coming into direct contact with affected sediments. Such contact has been shown to result in PAH uptake in aquatic species (Nakata, et al., 2003) because of ingestion of affected sediments. The constituents would have to biotransfer (trans-locate) from the sediment up through the roots, stalks, foliage and fruiting bodies for the crab to be exposed to the chemical. As observed from the previous discussion, this is unlikely to occur. The crab would therefore not be exposed to significant levels of constituents in its own feeding habits; its edible tissue would likewise not be affected.

*Local consumption practices:* it is reported normal practice in Puerto Rico to clean and boil crabs caught prior to consumption. The crab is fed a diet of corn and coconut meat while in captivity for a period of several days. The crabs are also served boiled. This would tend to reduce any contaminants that may be present in the crab meat.

*Restricted access to affected area:* the majority of reported PAHs were detected in the portion of the affluent channel that is under the jurisdiction of the refinery; therefore access to this area can be controlled by fencing. Trespassers would not be able to enter this area and harvest in crabs in this area. The discharge point of the channel is accessible to trespassers; however, the PAHs values here were among the lowest reported in the entire database.

#### **4. Conclusions**

The foregoing discussion suggests that consumption of the giant land crab is not a complete pathway for exposure to chemical constituents that have been reported in soil and sediment in areas adjacent to the refinery. This conclusion is based on the low tendency for site constituents to bioaccumulate within a food chain and a high tendency

for their metabolism and excretion. In addition, the feeding biology of the crab does not bring it into direct contact with affected sediments, thereby lessening the likelihood that the crab will ingest sediment constituents. Finally, access to the most affected areas (the upper reaches of the effluent channel) can be controlled, thus preventing trespassers and fishermen from entering and harvesting crabs in the area.

## **5. References**

Applied Geosciences and Environmental Services, Inc. *Results of a Site Assessment Program for Environmental Indicators, Flores Park, Commonwealth Oil Refining Company, Penuelas, Puerto Rico*, September 8 2005a.

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